AECOM Environment

Submitted to:
Sumitomo Metal Mining Pogo LLC
Delta Junction, Alaska

Submitted by:
AECOM
Fort Collins, Colorado
60284905.1500
August 2013

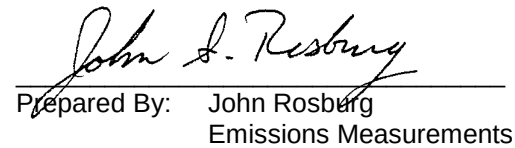
Sumitomo Metal Mining Pogo LLC
Unit 412 Incinerator Test Report

AECOM Environment

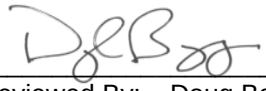
Submitted to:
Sumitomo Metal Mining Pogo LLC
Delta Junction, Alaska

Submitted by:
AECOM
Fort Collins, Colorado
60284905.1500
August 2013

Sumitomo Metal Mining Pogo LLC Unit 412 Incinerator Test Report



Prepared By: John Rosburg
Emissions Measurements Manager



Reviewed By: Doug Bopray
Air Quality Scientist

Executive Summary

Sumitomo Metal Mining Pogo LLC (Pogo) mine facility is located near Delta Junction, Alaska 99737. The Pogo facility operates under the Alaska Department of Environmental Conservation (ADEC), Air Quality Control Minor Permit NumberAQ0406MSS05, issued on May 12, 2011. In the operation of the facility, Pogo employs Unit 412 which is an incinerator used to burn facility waste. In preparation for demonstrating compliance with the Commercial and Industrial Waste Incinerator (CISWI) emission standards, Pogo conducted an emissions measurements evaluation of the Unit 412. The test program was designed to evaluate Unit 412 pollutant emission rates and determine what, if any, pollution controls are needed to achieve compliance. The field measurements of Unit 412 included the following:

- Particulate (PM);
- Nitrogen Oxides (NO_x);
- Dioxins and Furans (D/F);
- Cadmium (Cd);
- Mercury (Hg);
- Sulfur Dioxide (SO_2);
- Carbon Monoxide (CO);
- Hydrochloric Acid (HCl); and
- Lead (Pb).

The measurements and analytical procedures followed for this test project are accepted United States Environmental Protection Agency (USEPA) Reference Method (RM) procedures and defined in the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A. The measurements results are provided in the same engineering units as the applicable emissions standards and emission rate for ease of evaluation.

Pogo retained AECOM, Technical Services, Inc. (AECOM) to perform the required emissions measurements. AECOM is located at 1601 Prospect Parkway, Fort Collins, Colorado 80525-9769. Mr. John Rosburg, AECOM Emissions Measurements Manager, is the Project Manager for this test program. Mr. Rosburg may be reached by telephone at (970) 219-4904 or by e-mail at john.rosburg@aecom.com. Ms. Sally McLeod Pogo's Environmental Manager was responsible for the coordination of the test program and collection of process data. Ms. McLeod may be reached by telephone at (907) 895-2879, by cell phone at (907) 978-3774, or by e-mail at Sally.Mcleod@smmpogo.com.

Three valid RM5/26A, RM 23 and RM 29 sample runs were performed at the Unit 412 incinerator test location. In addition, seven nitrogen oxides, sulfur dioxide and carbon monoxide CEMS sample runs were conducted at the Unit 412 test location. **Table ES-1** provides the average results of the measurements conducted. The average results are provided in terms of pertinent concentrations (mg/dscm @ 7% O_2, ppmvd, ppmvd @ 7% O_2, and ng/dscm@ 7% O_2).

Table ES-1 Unit 412 Average Measurements Results
Sumitomo Metal Mining Pogo LLC

Test Parameter	Average Results			
	(mg/dscm) * @ 7% O_2	(ppmvd)	(ppmvd) * @ 7% O_2	(ng/dscm) * @ 7% O_2
Particulate	89.33	NA	NA	NA
Sulfur Dioxide	NA	22.2	29.7	NA
Nitrogen Oxides	NA	69.7	93.2	NA
Carbon Monoxide	NA	1.3	1.8	NA
Dioxin and Furan	NA	NA	NA	0.115
Hydrogen Chloride	NA	141.1	190.8	NA
Cadmium	0.0449	NA	NA	NA
Lead	0.2470	NA	NA	NA
Mercury	0.0038	NA	NA	NA

* Results corrected to an oxygen content of seven percent.

Contents

List of Appendices

List of Tables

List of Figures

1.0 Introduction

Sumitomo Metal Mining Pogo LLC (Pogo) mine facility is located near Delta Junction, Alaska 99737. The Pogo facility operates under the Alaska Department of Environmental Conservation (ADEC), Air Quality Control Minor Permit NumberAQ0406MSS05, issued on May 12, 2011. In the operation of the facility, Pogo employs Unit 412 which is an incinerator used to burn facility waste. In preparation for demonstrating compliance with the Commercial and Industrial Waste Incinerator (CISWI) emission standards, Pogo conducted an emissions measurements evaluation of the Unit 412. The test program was designed to evaluate Unit 412 pollutant emission rates and determine what, if any, pollution controls are needed to achieve compliance. The field measurements of Unit 412 included the following:

- Particulate (PM);
- Nitrogen Oxides (NO_x);
- Dioxins and Furans (D/F);
- Cadmium (Cd);
- Mercury (Hg);
- Sulfur Dioxide (SO_2);
- Carbon Monoxide (CO);
- Hydrochloric Acid (HCl); and
- Lead (Pb).

The measurements and analytical procedures followed for this test project are accepted United States Environmental Protection Agency (USEPA) Reference Method (RM) procedures and defined in the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A. The measurements results are provided in the same engineering units as the applicable emissions standards and emission rate for ease of evaluation.

Pogo retained AECOM, Technical Services, Inc. (AECOM) to perform the required emissions measurements. AECOM is located at 1601 Prospect Parkway, Fort Collins, Colorado 80525-9769. Mr. John Rosburg, AECOM Emissions Measurements Manager, is the Project Manager for this test program. Mr. Rosburg may be reached by telephone at (970) 219-4904 or by e-mail at john.rosburg@aecom.com. Ms. Sally McLeod Pogo's Environmental Manager was responsible for the coordination of the test program and collection of process data. Ms. McLeod may be reached by telephone at (907) 895-2879, by cell phone at (907) 978-3774, or by e-mail at Sally.Mcleod@smmpogo.com.

The following test report is organized as follows: the testing approach is provided in Chapter 2.0; a description of the process and operations is provided in Chapter 3.0; source test methodology, calculations, and nomenclature are presented in Chapter 4.0; a concise description of the quality assurance/quality control (QA/QC) procedures implemented are provided in Chapter 5.0; copies of the field data sheets used and continuous emission monitor system (CEMS) 1-minute data averages are provided in **Appendix A**; copies of the laboratory results are provided in **Appendix B**; **Appendix C** contains copies of the equipment calibrations pertinent to this test program; located in **Appendix D** are copies of the process information recorded during the test program.

2.0 Test Approach

The test plan and protocol outlined specific methods and procedures for quantifying average PM, SO_2, NO_x, CO, D/F, HCl, Cd, Pb, and Hg emissions results from the Unit 412. All measurements and procedures followed for this project are accepted United States Environmental Protection Agency (USEPA) Reference Method (RM) procedures and are defined in the Code of Federal Regulations, Title 40, Part 60 (40 CFR 60), Appendix A. **Table 2-1** provides a test matrix for the source tested and includes the test parameter, methods followed, number of sample runs and run duration. The test matrix shown in **Table 2-1** is based on the performance test requirements of the CISWI rule for small remote incinerators (see 40 CFR 60 Subpart CCCC, Table 8).

Table 2-1 Unit 412 Test Matrix
Sumitomo Metal Mining Pogo LLC

Source ID	Test Type	Test Parameter	Method	Number of Runs	Minimum Sample Volume	Minimum Run Duration
Incinerator	Performance Test	Sample Points	RM 1	1	NA	NA
		Velocity	RM 2	3	NA	60 min
		Molecular Weight (O_2 & CO_2)	RM 3A	3	NA	NA
		Moisture	RM 4	3	21 dscf/run	60 min
		Particulate	RM 5	3	1 dscm/run	60 min
		Sulfur Dioxide	RM 6C	3	NA	60 min
		Nitrogen Oxides	RM 7E	3	NA	60 min
		Carbon Monoxide	RM 10	3	NA	60 min
		Dioxin/Furan	RM 23	3	1 dscm/run	120 min
		Hydrochloric Acid	RM 26A	3	1 dscm/run	60 min
		Metals (Cd, Pb, Hg)	RM 29	3	2 dscm/run	120 min

Pogo submitted a test plan to the ADEC in accordance with the timeline specified in ADEC, Air Quality Control Minor Permit Number AQ0406MSS05, Condition 26. Condition 26 states that before conducting any source test, the Permittee shall submit a plan to the Department. The test plan included a description of the methods and procedures to be used for sampling, quality assurance and quality control activities implemented, how the source was to be operated during the test and how the Permittee was to document that operation. The Permittee shall submit a complete plan within 60 days after receiving a request under Condition 24 and at least 30 days before the scheduled date of any test unless the Department agrees in writing to some other time period. Further, at least 10 days before conducting a source test, the Permittee shall give the Department written notice of the date and the time the source test will begin. The appropriate notifications were provided to the ADEC as required.

2.1 Schedule

The field program was performed on June 28 through 30, 2013. On Day 1 of the field effort, AECOM prepared the equipment for testing. Days 2 through 4 entailed the performance of three combined PM and HCl sample runs, three metals (Cd, Pb, Hg) sample runs, three D/F sample runs and seven combined NO_x, SO_2, CO, O_2 and CO_2 sample runs. On Day 5 demobilization of the equipment and field crew, as well as, sample shipping occurred.

2.2 Equipment Preparation

All equipment was prepared and calibrated in accordance with USEPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III; Stationary Source Specific Methods, 40 CFR 60, Appendix A; and AECOM's general QA/QC policy described in Chapter 5.0 of this report. These

procedures meet or exceed all USEPA requirements and guidelines for equipment maintenance and calibration. All equipment was in proper working order prior during the test program.

2.3 Summary of Field Measurements

The Unit 412 incinerator test program was performed according to approved USEPA methods. The methods selected and listed in **Table 2-1** above are applicable for the determination of the pollutant parameters required by the CISWI Rule. The field measurements results, presented in the following tables, are provided in the same engineering units as the CISWI Rule emission standards to facilitate the evaluation of compliance status and determine if pollution control is necessary.

The PM/HCl, metals (Cd, Pb, Hg) and D/F samples were withdrawn isokinetically from the source and collected on the front-half and condensate portions of the sample train. The sample volumes collected during each run are specific to the pollutant parameter and dictated by the CISWI Rule. A total of three, 72-minute, sample runs were performed for combined PM/HCl. A total of three, sample run time of 120 minutes or greater, sample runs were performed for metals (Cd, Pb, Hg). A total of three, run time of 120 minutes or greater, sample runs were performed for D/F.

The gaseous pollutant (SO_2, NO_x, CO) and diluents (O_2 and CO_2) parameters were measured with a CEMS. A total of seven, with six of them being 60-minutes or greater, sample runs were performed. The responses of the CEMS instruments were digitally recorded, at one minute intervals, using a Campbell Data Acquisition System (DAS). The CEMS were calibrated with certified Protocol 1 calibration gas standards.

2.4 Particulate and Hydrogen Chloride Results

The particulate and HCl samples were collected simultaneously following RM 5 and RM 26A which were combined as allowed by the methods procedures. One, 72-minute sample was collected each of three consecutive test days. A total of 24 traverse points were sampled, 12 through each of the two test ports located a 90 degrees to each other in the same measurement plane. The particulate gravimetric analysis and HCl ion chromatography analysis were performed by TestAmerica located in West Sacramento, California. The particulate and HCl sample results are provided in **Table 2-2**. The table presents the average of the recorded measured effluent parameters, calculated effluent volumetric flow rates, particulate results and HCl results.

The acetone blank residue concentration results are near the detection limit and no acetone blank residue mass was subtracted from each sample's acetone residue results. The particulate concentration (mg/dscm @ 7% O_2) ranged from 72.06 mg/dscm at 7 percent O_2 for Run I5-1 to 112.41 mg/dscm at 7 percent O_2 for Run I5-2. The average particulate concentration for the sample series is 89.33 mg/dscm at 7 percent O_2.

The HCl blank residue concentration results were below the detection limit, therefore, no HCl blank corrections were performed on the HCl sample results. The HCl concentration (ppmv @ 7% O_2) ranged from 156 ppmv at 7 percent O_2 for Run I5-1 to 257 ppmv at 7 percent O_2 for Run I5-2. The average HCl concentration for the sample series is 191 ppmv at 7 percent O_2.

Table 2-2 Unit 412 Particulate and Hydrogen Chloride Results
Sumitomo Metal Mining Pogo LLC

Test Parameters	I5-1 06/28/13 0839-0954	I5-2 06/29/13 1305-1419	I5-3 06/30/13 1349-1508	Average
Sample Time (min)	72	72	74	73
Vol meter (acf)	54.010	61.528	62.455	59.331
Ave. SQRT dP (in WC)1/2	0.100	0.107	0.104	0.104
dH (in WC)	1.57	2.00	1.96	1.84
T stack (F)	1355.2	1236.5	1211.6	1267.8
T meter (F)	74.5	84.3	92.4	83.7
P static (in WC)	0.04	0.04	0.04	0.04
P bar (in Hg)	28.60	28.55	28.50	28.55
P stack (in WC)	28.60	28.55	28.50	28.55
H2O Mass Gain (g)	151.30	175.70	177.00	168.00
Yd (meter coef.)	0.970	0.970	0.970	0.970
dH @ (in WC)	1.896	1.896	1.896	1.90
Cp (pitot coef.)	0.84	0.84	0.84	0.84
Dia stack (in)	30.0	30.0	30.0	30.0
Dia nozzle (in)	0.867	0.875	0.875	0.872
CO_2 (%)	6.24	7.55	7.62	7.14
O_2 (%)	11.28	10.45	10.26	10.66
Vol meter (std) (dscf)	49.639	55.492	55.404	53.512
Vol meter (std) (dscm)	1.41	1.57	1.57	1.52
Md (lb/lb-mole)	29.45	29.63	29.63	29.57
Ms (lb/lb-mole)	28.01	28.12	28.11	28.08
Vwc	7.12	8.27	8.33	7.91
H_2O (%)	12.5	13.0	13.1	12.9
ISO (%)	106.8	106.2	106.4	106.5
Flow Rate				
Velocity (ft/s)	10.8	11.2	10.7	10.9
Vol. Flow Rate (acfm)	3,183	3,305	3,165	3,218
Vol. Flow Rate (wscfm)	885	982	952	940
Vol. Flow Rate (dscfm)	774	854	828	819
Filterable Particulate Results				
Filter Mass Gain (mg)	19.6	31.8	36.6	29.3
Acetone Rinse Mass Gain (mg)	50.5	101.0	63.7	71.7
Filterable Particulate Mass Gain (mg)	70.1	132.8	100.3	101.1
Particulate Concentration (lb/dscf)	3.11E-06	5.28E-06	3.99E-06	4.13E-06
Particulate Concentration (gr/dscf)	0.0218	0.0369	0.0279	0.0289
Particulate Concentration (mg/dscm)	49.87	84.51	63.93	66.11
Particulate Conc. (mg/dscm) @ 7% O2	72.06	112.41	83.52	89.33
Particulate Emission Rate (lb/hr)	0.14	0.27	0.20	0.20
Hydrochloric Acid Results				
HCl Mass (mg)	230	460	290	327
HCl Concentration (lb/dscf)	1.02E-05	1.83E-05	1.15E-05	1.3343E-05
HCl Concentrtion (ppmv)	108	193	122	141
HCl Concentration (ppmv) @ 7% O2	156	257	159	191
HCl Emission Rate (lb/hr)	0.47	0.94	0.57	0.66

2.5 Cadmium, Lead and Mercury Results

The cadmium, lead and mercury samples were collected simultaneously following RM 29. One, approximately 120-minute sample was collected each of three consecutive test days. A total of 24 traverse points were sampled, 12 through each of the two test ports located a 90 degrees to each other in the same measurement plane. The metals analysis was performed by TestAmerica located in West Sacramento, California. The cadmium, lead and mercury sample results are provided in **Table 2-3**. The table presents the average of the recorded measured effluent parameters, calculated effluent volumetric flow rates and metals results.

The cadmium, lead and mercury blank residue concentration results are 0.086 ug/sample, 0.31 ug/sample and 0.035 ug/sample respectively. The cadmium, lead and mercury blank residue mass was subtracted from each sample's results.

The cadmium concentration (mg/dscm @ 7% O_2) ranged from 0.02 mg/dscm at 7 percent O_2 for Run I29-3 to 0.08 mg/dscm at 7 percent O_2 for Run I29-1. The average cadmium concentration for the sample series is 0.04 mg/dscm at 7 percent O_2.

The lead concentration (mg/dscm @ 7% O_2) ranged from 0.08 mg/dscm at 7 percent O_2 for Run I29-3 to 0.37 mg/dscm at 7 percent O_2 for Run I29-2. The average lead concentration for the sample series is 0.25 mg/dscm at 7 percent O_2.

The mercury concentration (mg/dscm @ 7% O_2) ranged from 0.0009 mg/dscm at 7 percent O_2 for Run I29-3 to 0.0084 mg/dscm at 7 percent O_2 for Run I29-1. The average mercury concentration for the sample series is 0.0038 mg/dscm at 7 percent O_2.

2.6 Dioxin and Furan Results

The dioxin and furan samples were collected simultaneously following RM 23. One sample run was performed during each of three consecutive test days. The first sample run performed was 160 minutes in duration. The second and third sample runs were 120 minutes and 123 minutes respectively. A total of 24 traverse points were sampled, 12 through each of the two test ports located a 90 degrees to each other in the same measurement plane. Two sample fractions (front half and back half) were submitted to and analyzed by Analytical Perspectives of Wilmington, North Carolina. Each front half sample was composed of a probe wash and filter. Each back half sample included a rinse and XAD-2 resin trap.

Included in **Table 2-4** are the averages of the recorded dioxin and furan test parameters such as stack temperature, meter temperature, pressure, etc. Also included in this table are calculations of effluent molecular weight (wet and dry), moisture content, and isokinetics. In addition, the calculated effluent volumetric flow rates are provided.

The dioxin and furan results are provided in terms of toxicity equivalence (TEQ) concentration (nano-grams per cubic meter [TEQ ng/m^3], and TEQ concentration nano-grams per cubic meter corrected to 7 percent oxygen [TEQ ng/m^3 @ 7% O_2] and emission rate (nano-grams per second [ng/s]).

Table 2-5 presents the total dioxin and furan results of the three sample runs and the average of the triplicate test series. The total dioxin and furan concentration ranged from 0.0545 TEQ ng/m^3 @ 7% O_2 for Run I23-1 to 0.2176 TEQ ng/m^3 @ 7% O_2 for Run I23-2. The average dioxin and furan concentration is 0.1154 TEQ ng/m^3 @ 7% O_2.

Table 2-3 Unit 412 Cadmium, Lead and Mercury Results Sumitomo Metal Mining Pogo LLC

Test Parameters	I29-1 06/28/13 1107-1312	I29-2 06/29/13 1536-1740	I29-3 06/30/13 0722-0929	Average
Sample Time (min)	120	120	122	121
Vol meter (acf)	90.798	101.451	99.766	97.338
Ave. SQRT dP (in WC)1/2	0.10	0.11	0.10	0.10
dH (in WC)	1.56	1.94	1.81	1.77
T stack (F)	1378.5	1210.2	1203.6	1264.1
T meter (F)	91.1	93.5	73.7	86.1
P static (in WC)	0.04	0.04	0.04	0.04
P bar (in Hg)	28.60	28.55	28.50	28.55
P stack (in WC)	28.60	28.55	28.50	28.55
H_2O Mass Gain (g)	283.60	282.00	253.10	272.90
Yd (meter coef.)	0.970	0.970	0.970	0.970
dH @ (in WC)	1.896	1.896	1.896	1.896
Cp (pitot coef.)	0.84	0.84	0.84	0.84
Dia stack (in)	30.0	30.0	30.0	30.0
Dia nozzle (in)	0.867	0.875	0.875	0.872
CO_2 (%)	6.01	7.28	7.75	7.01
O_2 (%)	11.22	10.65	10.13	10.67
Vol meter (dscf)	80.939	89.963	91.573	87.491
Vol meter (dscm)	2.29	2.55	2.59	2.48
Md (lb/lb-mole)	29.41	29.59	29.65	29.55
Ms (lb/lb-mole)	27.79	28.10	28.30	28.07
Vwc	13.35	13.27	11.91	12.85
H_2O (%)	14.2	12.9	11.5	12.8
ISO (%)	106.7	104.1	106.8	105.9
Flow Rate				
Velocity (ft/s)	10.9	10.9	10.5	10.8
Vol. Flow Rate (acfm)	3,216	3,223	3,092	3,177
Vol. Flow Rate (wscfm)	883	972	935	930
Vol. Flow Rate (dscfm)	758	847	827	811
Metals Results				
Cd Mass (ug)	130.0	62.0	41.0	77.7
Cd Blank (ug)	0.086	0.086	0.086	0.086
Cd Blank Corrected mass (ug)	129.91	61.91	40.91	77.58
Cd Concentration (ug/dscm)	56.68	24.30	15.78	32.25
Cd Concentration (mg/dscm @ 7% O_2)	0.08	0.03	0.02	0.04
Cd Concentration (lb/dscf)	1.54E-09	5.96E-10	3.80E-10	8.40E-10
Cd Emission Rate (lb/hr)	7.02E-05	3.03E-05	1.89E-05	3.98E-05
Pb Mass (ug)	470.0	690.0	160.0	440.0
Pb Blank (ug)	0.31	0.31	0.31	0.310
Pb Blank Corrected Mass (ug)	469.7	689.7	159.7	439.69
Pb Concentration (ug/dscm)	204.9	270.7	61.6	179.08
Pb Concentration (mg/dscm @ 7% O_2)	0.29	0.37	0.08	0.25
Pb Concentration (lb/dscf)	5.58E-09	6.63E-09	1.48E-09	4.57E-09
Pb Emission Rate (lb/hr)	0.0003	0.0003	0.0001	0.0002
Hg Empty Mass (ug)	1.10	0.00	0.54	0.55
Hg Front Half (ug)	0.22	0.17	0.01	0.13
Hg HCl (ug)	3.00	1.40	0.43	1.61
Hg KMnO4 (ug)	0.00	0.00	0.00	0.00
Hg H2O2 (ug)	9.20	2.00	0.94	4.05
Hg Blank Sum (ug)	0.035	0.035	0.035	0.035
Hg Blank Corrected Mass (ug)	13.49	3.54	1.88	6.30
Hg Concentration (ug/dscm)	5.88	1.39	0.73	2.67
Hg Concentration (mg/dscm @ 7% O_2)	0.0084	0.0019	0.0009	0.0038
Hg Concentration (lb/dscf)	3.67E-10	8.66E-11	4.53E-11	1.66E-10
Hg Emission Rate (lb/hr)	1.67E-05	4.40E-06	2.25E-06	7.79E-06

Table 2-4 Unit 412 Average Measured Test Parameters
Sumitomo Metal Mining Pogo LLC

Test Parameters	I23-1 06/28/13 1411-1656	I23-2 06/29/13 0921-1125	I23-3 06/30/13 1037-1244	Average
Sample Time (min)	160	120	123	134
Vol meter (acf)	122.129	92.270	106.195	106.865
Ave. SQRT dP (in WC)1/2	0.100	0.098	0.107	0.102
dH (in WC)	1.68	1.67	2.05	1.80
T stack (F)	1272.4	1274.3	1224.3	1257.0
T meter (F)	84.6	77.8	94.4	85.6
P static (in WC)	0.04	0.04	0.04	0.04
P bar (in Hg)	28.60	28.55	28.50	28.55
P stack (in WC)	28.60	28.55	28.50	28.55
H2O Mass Gain (g)	383.40	272.70	282.70	312.93
Yd (meter coef.)	0.970	0.970	0.970	0.970
dH @ (in WC)	1.896	1.896	1.896	1.90
Cp (pitot coef.)	0.84	0.84	0.84	0.84
Dia stack (in)	30.0	30.0	30.0	30.0
Dia nozzle (in)	0.876	0.875	0.875	0.875
CO2 (%)	6.90	7.21	7.49	7.20
O2 (%)	10.92	10.85	10.40	10.72
Vol meter (std) (dscf)	110.202	84.165	93.889	96.086
Vol meter (std) (dscm)	3.12	2.38	2.66	2.72
Md (lb/lb-mole)	29.54	29.59	29.61	29.58
Ms (lb/lb-mole)	27.92	28.05	28.17	28.05
Vwc	18.05	12.84	13.31	14.73
H2O (%)	14.1	13.2	12.4	13.2
ISO (%)	103.6	107.3	105.2	105.4
Flow Rate				
Velocity (ft/s)	10.6	10.4	11.1	10.7
Vol. Flow Rate (acfm)	3,115	3,053	3,264	3,144
Vol. Flow Rate (wscfm)	908	887	975	923
Vol. Flow Rate (dscfm)	780	770	854	801

Table 2-5 Unit 412 Dioxin and Furan Results
Sumitomo Metal Mining Pogo LLC

	Run No.	I23-1		I23-2		I23-3			
	Date	06/28/13		06/29/13		06/30/13		Average	
	Time	1411-1656		0921-1125		1037-1244			
Sample Volume	dscf	110.202		84.165		93.889		96.086	
Sample Volume	m^3	3.12		2.38		2.66		2.72	
Moisture Content	% v/v	14.1		13.2		12.4		13.2	
O_2 Concentration	% v/v (dry)	10.92		10.85		10.40		10.72	
CO_2 Concentration	% v/v (dry)	6.90		7.21		7.49		7.20	
Isokinetics	%	104		107		105		105	
Stack Flowrate	dscfm	780		770		854		801	
PCDD / PCDF Parameters	TEF (a)	pg	ng/m^3 TEQ	pg	ng/m^3 TEQ	pg	ng/m^3 TEQ	pg	ng/m^3 TEQ
2,3,7,8-TCDD	1.00	(2.78)	0.0E+00	(5.37)	0.0E+00	(2.88)	0.0E+00	0.00	0.0E+00
1,2,3,7,8-PeCDD	0.50	4.46	7.1E-04	23.3	4.9E-03	18.3	3.4E-03	13.9	3.0E-03
1,2,3,4,7,8-HxCDD	0.10	8.39	2.7E-04	44.7	1.9E-03	25.1	9.4E-04	26.5	1.0E-03
1,2,3,6,7,8-HxCDD	0.10	41.3	1.3E-03	218	9.1E-03	(44)	0.0E+00	86.4	3.5E-03
1,2,3,7,8,9-HxCDD	0.10	(14.3)	0.0E+00	83.2	3.5E-03	32.7	1.2E-03	41.6	1.6E-03
1,2,3,4,6,7,8-HpCDD	0.01	609.0	2.0E-03	2,050	8.6E-03	615	2.3E-03	1,330	4.3E-03
OCDD	0.001	2,550	8.2E-04	5,280	2.2E-03	2,300	8.7E-04	3,915	1.3E-03
2,3,7,8-TCDF	0.10	(7.7)	0.0E+00	39.9	1.7E-03	22	8.3E-04	21	8.3E-04
1,2,3,7,8-PeCDF	0.05	(12.5)	0.0E+00	97.2	2.0E-03	55.4	1.0E-03	50.9	1.0E-03
2,3,4,7,8-PeCDF	0.50	65.1	1.0E-02	237	5.0E-02	103	1.9E-02	135	2.7E-02
1,2,3,4,7,8-HxCDF	0.10	74.2	2.4E-03	328	1.4E-02	102	3.8E-03	168	6.7E-03
1,2,3,6,7,8-HxCDF	0.10	112	3.6E-03	384	1.6E-02	150	5.6E-03	215	8.4E-03
2,3,4,6,7,8-HxCDF	0.10	395	1.3E-02	761	3.2E-02	338	1.3E-02	498	1.9E-02
1,2,3,7,8,9-HxCDF	0.10	(4.79)	0.0E+00	(9.22)	0.0E+00	(5.69)	0.0E+00	0.00	0.0E+00
1,2,3,4,6,7,8-HpCDF	0.01	1,240	4.0E-03	2,360	9.9E-03	813	3.1E-03	1,800	5.6E-03
1,2,3,4,7,8,9-HpCDF	0.01	191	6.1E-04	376	1.6E-03	150	5.6E-04	284	9.2E-04
OCDF	0.001	1,600	5.1E-04	1,900	8.0E-04	922	3.5E-04	1,750	5.5E-04
TOTAL TEQs (ng/m^3)		=	0.0392		0.1577		0.0562		0.0844
TOTAL TEQs (ng/m^3 @ 7 % O_2)		=	0.0545		0.2176		0.0742		0.1154
TOTAL TEQs (ng/s)		=	0.0144		0.0573		0.0226		0.0315

(a) U.S.EPA (1989) Toxic Equivalency Factor (TEF)

Notes: Results below the detection limit are listed as the reporting limit, shown in parentheses, and treated as zero in the calculation of concentration on a TEQ basis.
If a parameter is detected in one fraction of the sample and not in the other, only the detected quantitiy is listed.
If a paramter is not detected in either fraction of the sample, the sum of the reporting limits is listed in parentheses.

2.7 Continuous Emission Monitor Results

Seven continuous emission monitor sample runs were performed at the Unit 412 exhaust stack test location over a two day period. Each CEMS sample run included the measurements of gaseous pollutant (SO_2, NO_x, CO) and diluents (O_2 and CO_2) parameters. Prior to the initiation of the CEMS measurements, the CEMS was calibrated with USEPA Protocol 1 calibration gas standards following RMs 3A, 6C, 7E and 10. A calibration bias check of the CEMS was performed prior to the initiation and upon completion of each sample run. The CEMS response was digitally recorded and averaged at 1-minute intervals. The 1-minute data averages were used to calculate sample run averages.

Table 2-6 presents the average results of the CEMS sample runs. The average results are presented in terms of concentration (ppmv and ppmv @ 7% O_2) and emission rate (lb/hr). The emission rate results provided in the table were calculated using the volumetric flow rate recorded by the corresponding isokinetic sample run conducted simultaneously with the CEMS sample run.

Table 2-6 Unit 412 Continuous Emission Monitor System Results
Sumitomo Metal Mining Pogo LLC

Date	Run Time	Isokinetic Run	O2 (%)	Flow Rate (dscfm)	NO_x			CO			SO_2		
					(ppm)	(ppm@7%O_2)	(lb/hr)	(ppm)	(ppm@7%O_2)	(lb/hr)	(ppm)	(ppm@7%O_2)	(lb/hr)
06/29/13	0844-1124	I23-2	10.85	770	69.2	95.7	0.38	2.1	3.0	0.01	17.5	24.2	0.13
06/29/13	1358-1458	I5-2	10.45	854	69.5	92.4	0.43	2.4	3.2	0.01	16.9	22.5	0.14
06/29/13	1515-1615	I29-2	10.65	847	68.8	93.3	0.42	1.1	1.5	0.00	36.6	49.6	0.31
06/29/13	1629-1729	I29-2	10.65	847	65.5	88.9	0.40	0.8	1.1	0.00	23.1	31.3	0.19
06/30/13	0811-0931	I29-3	10.13	827	67.2	86.7	0.40	1.5	2.0	0.01	26.3	34.0	0.22
06/30/13	0959-1129	I23-3	10.40	854	67.0	88.7	0.41	0.1	0.2	0.00	16.8	22.3	0.14
06/30/13	1157-1252	I23-3	10.40	854	80.5	106.5	0.49	1.2	1.5	0.00	18.0	23.9	0.15
Average			10.50	836	69.7	93.2	0.42	1.3	1.8	0.00	22.2	29.7	0.19

3.0 Process Description and Operation

3.1 Process Description

Unit 412 is an ACS, Inc., Model CA 400, industrial waste incinerator is used to reduce the amount of waste transported off site from the Pogo facility. The unit is fired by propane. The capacities of the unit are as follows:

- Rated Capacity of 240 Lb/hr - Type '0' Waste;
- Rated Capacity of 400 Lb/hr - Type '1' Waste;
- Rated Capacity of 480 Lb/hr - Type '2' Municipal Solid Waste; and
- Rated Capacity of 240 Lb/hr - Type '3' Waste.

3.2 Process Operation

The emission measurements of Unit 412 were conducted under normal and representative process operations at the maximum achievable waste burning rate at the time of testing. For all measurements associated with Unit 412, all pertinent process and control device operations data were monitored and recorded. The following parameters were monitored and recorded during each sample run;

- Weight of each batch loaded into the incinerator;
- Time interval between batches loaded;
- Primary oven temperature at a minimum of 5- to 6-minute intervals;
- Secondary oven temperature at a minimum of 5- to 6-minute intervals;
- Primary oven burn time following loading of final batch; and
- Secondary burn time following completion of the primary burn cycle.

Table 3-1 presents a summary of the process parameters recorded during the measurements program. Included in the table is the date, time and associated run identification (ID) of the process data collected. For each sample run, the average primary and secondary temperature (F) is listed. In addition the total weight (lb) of each charge type and total charge weight (lb) are presented. The actual process operations data for the time periods during which testing was conducted are provided in **Appendix D** of this test report.

Table 3-1 Unit 412 Summary of Process Operations
Sumitomo Metal Mining Pogo LLC

Date	Time	Run ID	Average Primary (F)	Average Secondary (F)	Type 2 Waste (lb)	Type 3 Waste (lb)	Sludge (lb)	Oily Rags (lb)	Total Charge (lb)
06/28/13	0839-0956	I5-1	1,569	1,830	71	75	29	30	205
06/28/13	1102-1312	I29-1	1,652	1,834	130	102	103	13	348
06/28/13	1411-1700	I23-1	1,656	1,836	124	292	29	0	445
06/29/13	0919-1127	I23-2	1,670	1,838	151	159	70	0	380
06/29/13	1304-1421	I5-2	1,662	1,838	74	89	37	43	243
06/29/13	1533-1742	I29-2	1,640	1,838	74	177	66	0	317
06/30/13	0719-0929	I29-3	1,418	1,781	144	163	36	12	355
06/30/13	1034-1244	I23-3	1,539	1,836	121	159	74	28	382
06/30/13	1348-1509	I5-3	1,526	1,835	92	57	36	13	198

4.0 Methodology

The testing program was performed according to the following accepted and approved USEPA RMs as contained in the USEPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, 40 CFR 60, Appendix A. The general procedures that were followed for this measurements evaluation included:

- RM 1 – Sample Velocity Traverse for Stationary Sources;
- RM 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube);
- RM 3A – Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure);
- RM 4 – Determination of Moisture Content In Stack Gases;
- RM 5 – Determination of Particulate Matter Emissions from Stationary Sources;
- RM 6C – Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure);
- RM 7E – Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure);
- RM 10 – Determination of Carbon Monoxide Emissions from Stationary Sources;
- RM 023 – Determination of Polychlorinated Dibenzo-p-dioxin and Polychlorinated Dibenzofuran Emissions from Municipal Waste Combustors;
- RM 26A – Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Isokinetic Method; and
- RM 29 – Determination of Metals Emissions from Stationary Sources.

4.1 Support Measurements for Stack Parameters

USEPA RMs 1 through 4 were performed in support of the emissions measurements procedures selected for quantifying pollutant emission rates. RM 1, selection of sample points for velocity and particulate traverses, was conducted prior to the initiation of any emission measurements at test location. The determination of stack gas flow rate, molecular weight, and moisture content (RMs 2 through 4) were integrated into and performed concurrently with each isokinetic sample run.

4.1.1 Selection of Traverse Points by Reference Method 1

USEPA RM 1, "Sample Velocity Traverses for Stationary Sources," was followed for the selection of measurement points at the test location. The physical characteristics of the test location meet the minimum criteria of RM 1 for isokinetic sampling. The calculated measurement points were used for all isokinetic sample runs. A copy of the RM 1 data form completed prior to sampling is located in **Appendix A** of this report.

4.1.2 Flow Rate Determination by Reference Method 2

USEPA RM 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type-S Pitot Tube)," was followed to measure the volumetric flow rate during each sample run at the sample location. This method was incorporated into, and conducted concurrently with, each isokinetic sample run.

RM 2 allows for a stainless steel Type-S or standard pitot tube to be connected to a differential pressure gauge (inclined manometer). The measured pressure differential, observed at each traverse point, was recorded on field data forms and used in determining the overall emission rate for each constituent.

In addition to velocity pressures, gas temperatures were measured and recorded concurrently with all differential pressure data. The temperature was measured with a Type K thermocouple located at the measurement tip of the pitot tube (in the same measurement plane). The Type K thermocouple was connected directly to a calibrated digital temperature indicator for accurate measurements.

4.1.3 Molecular Weight Determination by Reference Method 3

USEPA RM 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)," was conducted concurrently with the pollutant measurements at the test location. During the first sample day, integrated gas samples were collected in Tedlar bags and subjected to a combination O_2/CO_2 analyzer. During the second and third sample days sample gas was continuously extracted from the Unit 412 exhaust stack and directed to a combination O_2/CO_2 analyzer. Diluent O_2 and CO_2 data collected during the course of the sampling was used to determine effluent gas dry molecular weight in accordance with USEPA RM 3A. The results of the O_2 and CO_2 analysis were used for the determination of effluent molecular weight.

USEPA RM 3A analyzer calibration requirements include; three point calibrations using USEPA Protocol 1 gas standards, and stringent instrument drift requirements. Calibrations will be completed at 80 to 100 percent of the full span value, 40 to 60 percent of the full span value, and 0 percent of the full span value (ultra-pure nitrogen for both analyzers).

The O_2/CO_2 analyzer was subjected to a zero and two up-scale calibration gases prior to and upon completion of the sample runs when they were used continuously. The gas standards were certified and traceable to USEPA Protocol 1 specifications, which require that the gas concentration be within ±1 percent of the documented value. The response of the analyzers compared to each certified calibration standard must be within ±2 percent of the high calibration gas standard (CS) value for each component as required by the method.

To calibrate the instruments, the gas standards were introduced directly to the monitors at the sample inlet located on the back of each instrument. For the continuous measurements, the amount of bias of the O_2/CO_2 instrument was also determined. This was accomplished by introducing zero and one span gas to the instrument at the point at which the sample probe and heated sample filter are connected. The response of the analyzers to the direct zero and span gases (bias check) must be less than ±5 percent of the span value for each component as required by the method. The bias calibration check was performed prior to and upon completion of each sample run.

The magnitude of calibration drift was calculated for each continuous sample run. Calibration drift is the difference in the initial (pre-test) bias calibration response and the final (post-test) bias calibration response for the same gas standard. The calibration drift must be within ±3 percent of the CS over each sample run for each O_2/CO_2 gas standard as required by RM 3A.

4.1.4 Percent Moisture Determination by Reference Method 4

USEPA RM 4, "Determination of Moisture Content in Stack Gases," was incorporated into each isokinetic sample run. The determination of moisture content was accomplished by using a condenser and pump assembly, connected between a sample probe and metering system and performed concurrently with each sample run.

Throughout each isokinetic sample run, a known volume of gas (measured by a dry gas meter) was passed through the condenser assembly. Upon completion of each sample run, the total amount of

condensate collected was gravimetrically measured and the net gain calculated. The total moisture gain, volume of gas extracted, and measured meter temperature data was used to calculate the actual moisture content of the effluent.

4.2 Particulate Determination by Reference Method 5

USEPA RM 5, “Determination of Particulate Matter Emissions from Stationary Sources” was followed to determine particulate emission rates. Each RM 5 was conducted in accordance with all applicable USEPA quality assurance requirements

Samples were withdrawn isokinetically (100 percent ± 10 percent) from the source using a modular isokinetic sampling system. The sampling train consisted of a quartz glass nozzle and probe assembly, heated stainless steel probe with an S-Type pitot tube attached, a heated filter, four chilled impingers, and a metering console. The particulate sample was collected on a quartz fiber filter supported by a Teflon frit and maintained at a temperature of 248 ± 25°F. The impinger train was consistent with RM 5.

The system vacuum was used to extract the effluent gas through the interconnected, leak-free components. The entire system was “leak checked” before and after each individual sample run to ensure sample integrity following RM 5 procedures.

A “K-factor” (coefficient) was determined prior to the initiation of each sample run. This coefficient was based upon preliminary measurements of gas temperature, flow rate, pressure, and moisture content. Multiplying the K-factor by the measured differential pressure was used to determine the isokinetic sample rate for each sample point. If a variable changed during a sample run, the coefficient was adjusted to maintain isokinetic sampling rates. At isokinetic conditions, the velocity of the stack gas entering the nozzle of the extraction system will be equal to the effluent velocity at the sample point.

The quartz filter was removed from the filter holder and placed in a Petri dish and sealed. The impingers were recovered following RM 5 procedures. The RM 5 sample recovery was conducted in accordance with all applicable USEPA quality assurance requirements.

4.3 Sulfur Dioxide Determination by Reference Method 6C

Sulfur dioxide emissions were quantified at the Unit 412 exhaust stack according to USEPA RM 6C, “Determination of Sulfur Dioxide Emissions from Stationary Sources (Instrumental Analyzer Procedure).” This method allows for the determination of SO_2 concentrations by continuously extracting stack effluent and directing a portion of the sample to an SO_2 analyzer. An AMETEK Model 921M UV photometric SO_2 monitor was used to measure the concentration (parts per million [ppm] by volume) of the effluent at the test location on a dry basis.

RM 6C provides rigorous analyzer calibration requirements, including three point calibrations using USEPA Protocol 1 gas standards, and stringent instrument drift requirements. Calibrations were performed at 80 to 100 percent of the span value, 40 to 60 percent of the span value, and 0 percent of the span value (ultra-pure nitrogen).

The SO_2 analyzer was subjected to the zero and two up-scale calibration gases prior to and upon completion of the test series. The gas standards were certified and traceable to USEPA Protocol 1 specifications, which require that the gas concentration be within ±1 percent of the documented value. The response of the analyzer compared to each certified calibration standard must be within ±2 percent of the CS value for each component. To calibrate the instrument, the gas standards were introduced to the inlet of the SO_2 RM analyzer before and upon completion of each test series. The amount of bias of the SO_2 RM system was determined before and after each sample run. This was accomplished by delivering zero and one span gas directly to the point where the sample probe and heated sample filter

were connected. The response of the analyzer to the bias checks must be less than ±5 percent of the span value for each check.

The magnitude of calibration drift was also calculated. Calibration drift is the difference in the initial bias calibration response check and the final bias calibration response check for the same gas standard. The calibration drift must be within ±3 percent of the span for each sample run.

4.4 Nitrogen Oxides Determination by Reference Method 7E

USEPA RM 7E, "Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)," was used to accomplish the Unit 412 NO_X measurements. This method allows for the determination of NO_X concentrations by continuously extracting effluent from the stack and directing a portion of the sample to a NO_X analyzer. A TEI Model 42C Chemiluminescent NO_X analyzer was used to measure the concentration (ppm by volume) of the effluent at the stack on a dry basis.

USEPA RM 7E provides rigorous analyzer calibration requirements, including three point calibrations using EPA Protocol 1 gas standards, and stringent instrument drift requirements. Calibrations were completed at 80 to 100 percent of the span value, 40 to 60 percent of the span value, and zero percent of the span value (ultra-pure nitrogen).

The NO_X analyzer was subjected to a zero and two up-scale calibration gases prior to the performance of the sample runs. The gas standards were certified and traceable to USEPA Protocol 1 specifications, which require that the gas concentration is within ±1 percent of the documented value. The response of the analyzer compared to each certified calibration standard must be within ±2 percent of the CS for each component.

To calibrate the instrument, the gas standards were introduced directly to the NO_X monitor at the sample inlet located on the back of the instrument. The amount of bias of the NO_X CEM system was determined. This was accomplished by introducing zero and one span gas to the NO_X system at the point in which the sample probe and heated sample filter were connected. The response of the analyzer system to the zero and span gas (bias check) must be less than ±5 percent of the CS for each component. The bias calibration check was performed prior to, and upon completion of, each sample run

The magnitude of calibration drift was also calculated. Calibration drift is the difference in the initial (pre test) bias calibration response and the final (post test) bias calibration response for the same gas standard. The calibration drift must be within ±3 percent of the CS each sample run for each gas standard.

4.5 Carbon Monoxide Determination by Reference Method 10

The CO measurements were conducted according to USEPA RM 10, "Determination of Carbon Monoxide Emissions from Stationary Sources." Sample gas was continuously extracted from the test location and directed to a TEI Model 48C, Gas Filter Correlation (GFC), NDIR CO instrument for analysis. The GFC feature of the CO analyzer eliminates potential interference by substances, which absorb infrared energy.

USEPA RM 10 provides rigorous analyzer calibration requirements, including three point calibrations using EPA Protocol 1 gas standards, and stringent instrument drift requirements. Calibrations were completed at 80 to 100 percent of the span value, 40 to 60 percent of the span value, and zero percent of the span value (ultra-pure nitrogen).

The CO analyzer was subjected to a zero and two up-scale calibration gases prior to the performance of the sample runs. The gas standards were certified and traceable to USEPA Protocol 1 specifications, which require that the gas concentration is within ±1 percent of the documented value. The response of

the analyzer compared to each certified calibration standard must be within ±2 percent of the CS for each component.

To calibrate the instrument, the gas standards were introduced directly to the CO monitor at the sample inlet located on the back of the instrument. The amount of bias of the CO CEM system was determined. This was accomplished by introducing zero and one span gas to the CO system at the point in which the sample probe and heated sample filter are connected. The response of the analyzer system to the zero and span gas (bias check) must be less than ±5 percent of the CS for each component. The bias calibration check was performed prior to, and upon completion of, each sample run.

The magnitude of calibration drift was also calculated. Calibration drift is the difference in the initial (pre test) bias calibration response and the final (post test) bias calibration response for the same gas standard. The calibration drift must be within ±3 percent of the CS each sample run for each gas standard.

4.6 Dioxins and Furans Determination by Reference Method 23

USEPA RM 23, “Determination of Polychlorinated Dibenzo-p-dioxin and Polychlorinated Dibenzofuran Emissions from Municipal Waste Combustors,” was followed to determine D/F concentrations and emissions from the Unit 412 test location.

4.6.1 Sample Train Component Preparation

All glass parts of the sample train including the sorbent trap were pre-cleaned prior to sampling according to the following procedures.

- Soak in hot soapy water (Alconox) at 50°C or higher;
- Rinse three times with tap water;
- Rinse three times with deionized water;
- Rinse three times with pesticide grade acetone;
- Rinse three times with pesticide grade methanol/methylene chloride;
- Bake at 450ºF for 2 hours; and
- Seal with clean Teflon tape.

The glassware was sealed with Teflon tape followed by aluminum foil until sample train assembly. Following sample recovery, the glassware was reused at the same sampling location as allowed by the method.

The XAD-2 resin traps were pre-cleaned and prepared by Analytical Perspectives. Each sorbent trap was charged with 20 to 30 grams of the precleaned resin and the five surrogate compounds listed in Table 2 of RM 23 were added to the resin. Care was taken to ensure that the resin was kept at temperatures below 120°F during shipment and before and after sample collection to prevent resin decomposition. The time between charging the trap and use in the field was minimized and was not allowed to exceed 14 days. The sorbent traps were shipped from Analytical Perspectives to the Pogo facility under strict chain-of-custody (COC) documentation.

4.6.2 Sample Collection

Samples for D/F were withdrawn isokinetically from the source using an RM 23 sampling train as depicted in **Figure 4-1**. The sampling train consisted of a quartz glass nozzle and probe liner, a pretreated glass fiber filter maintained at a temperature of 248°F ± 25°F, a water-cooled condenser, a sorbent trap containing XAD-2 resin, five chilled impingers, and a metering console. The water-cooled

condenser and sorbent trap were arranged in a manner that allows the condensate to drain vertically through the trap. Gas entering the trap was maintained at or below 68°F. The first impinger (optional knockout) was empty, the second and third impingers each contained 100 ml of HPLC water, the fourth was empty, and the fifth contained pre-weighed silica gel. Sealing greases were not used on any portion of the sample train.

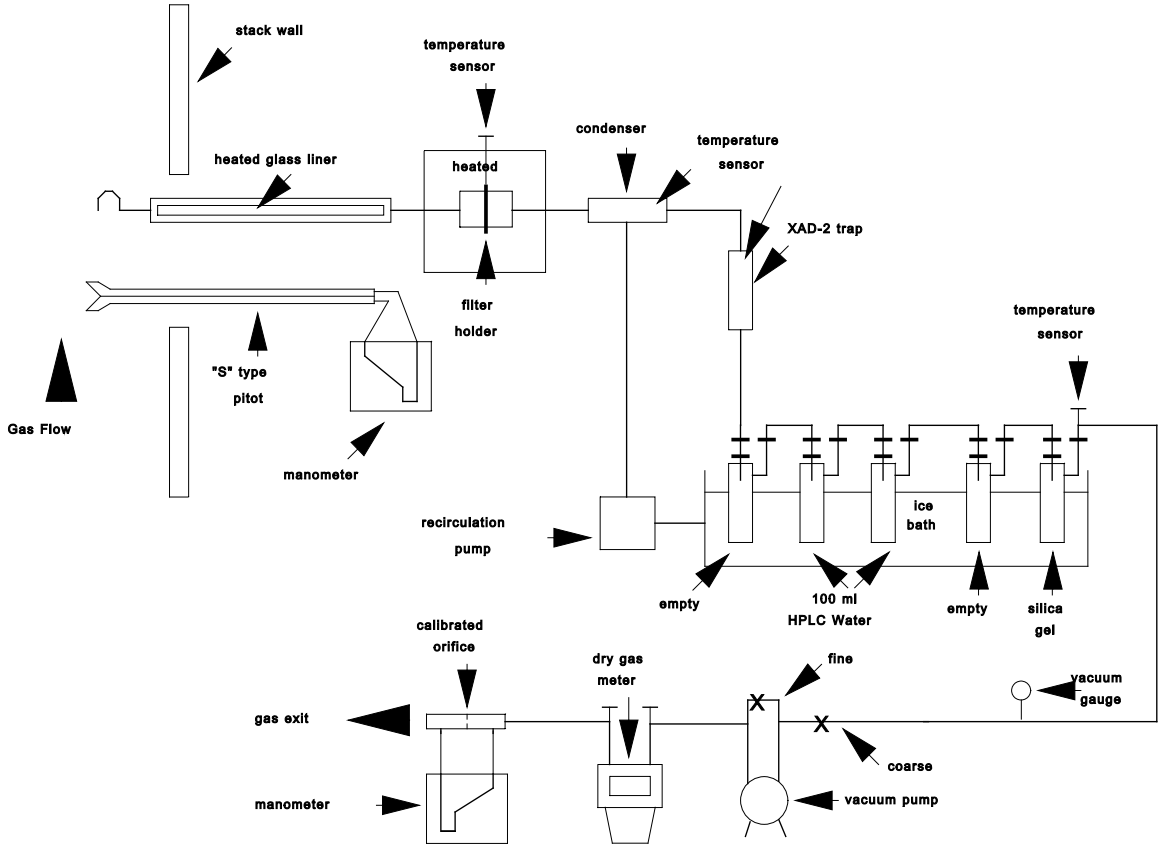


Figure 4-1 Reference Method 23 Sampling Train

4.6.3 Sample Recovery

Recovery of the samples and assembly of the sample trains for reuse was conducted in a dust-free environment. Each impinger and the XAD-2 trap was weighed prior to and at the conclusion of each sample run. The volume of water vapor condensed in the impingers, XAD resin and silica gel was summed and entered into moisture content calculations.

All sample-exposed components of the sampling train were rinsed with acetone and methylene chloride (rinses recovered per RM 23), and finally toluene. Sample containers from a typical run include the following.

- Container 1 – Filter(s);
- Container 2 – Rinses of nozzle, probe, and front-half of filter holder and rinses of back-half of filter holder and condenser;

- Container 3 – XAD cartridge and resin;
- Container 4 – Impinger contents; and
- Container 5 – Silica gel.

The samples, comprised of containers 1 through 3, were shipped to Analytical Perspectives, Inc. under strict COC documentation. Appropriate shipping containers were used to keep the samples cool during shipping.

4.6.4 Sample Analysis

The RM 23A samples were analyzed by Analytical Perspectives, Inc. in strict accordance with Analytical Perspective's QA Program. The filter(s), XAD-2 resin, toluene and methylene chloride rinses were analyzed for tetra-octa (4-8) D/F according to USEPA RM 23 with high-resolution gas chromatography/ high resolution mass spectrometry. All extracts from one run were analyzed in separate front half and back half sample fractions.

4.6.5 Data Reduction

The D/F results are expressed in terms of toxicity equivalents (TEQ), as specified in 40 CFR §63.1342. The D/F congeners (tetra, hepta, hexa and octa) were converted to TEQ using toxicity equivalence factors (TEFs), as the summation of the TEFs of the congeners, multiplied by their relative concentrations.

Any D/F congeners that are reported by Analytical Perspectives, Inc. as nondetected (below the method detection limit ND) are counted as zero for the purpose of calculating the total D/F TEQ concentration for that sample, as specified in RM 23 (§7.4).

4.7 Hydrogen Chloride Determination by Reference Method 26A

USEPA RM 26A, "Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Isokinetic Method," was followed for the determination of HCl emissions at the Unite 412 test location. This method was performed in conjunction with the particulate measurement procedures as allowed by the methods. Included in the RM 26A sampling system was a calibrated quartz glass nozzle and probe assembly, stainless steel probe, insulated filter oven, glass filter holder and tared quartz-fiber filter, condenser assembly, and calibrated extraction system. The system vacuum extracted the effluent sample gas through the interconnected, leak-free components. The entire system was "leak checked" before and after each individual sample run to ensure sample integrity.

A "K-factor" (coefficient) was determined prior to the initiation of each RM 26A sample run. This coefficient was based upon preliminary measurements of gas temperature, flow rate, pressure, and moisture content. Multiplying the K-factor by the measured differential pressure at each sample point provided for isokinetic sample rates for each sample point. If a variable changed during a sample run, the coefficient was adjusted to maintain isokinetic sample rates. At isokinetic conditions, the velocity of the stack gas entering the nozzle of the extraction system was equal to the effluent velocity at the sample point.

The condenser assembly consisted of a series of five glass impingers with glass inserts interconnected to each other by glass U-tubes, providing a "leak tight" seal with 28/15 ball and socket connections. The first and second impingers contained sulfuric acid (H_2SO_4). The third and fourth impingers contained sodium hydroxide (NaOH). The fifth impinger was filled with a pre-weighed amount of silica gel to capture any residual moisture from the sample stream. The impinger train was set in an ice bath to maintain the extracted gas outlet temperature at or below 70°F. By cooling the sample, all water vapor and gases were condensed and collected.

Three valid sample runs were performed at the test location. Upon completion of each sample run, the probe was removed from the effluent and allowed to cool. A leak check of the sampling system was then performed to verify the integrity of the system. The leak rate must not exceed 0.02 actual cubic feet per minute (acfm) in order for the test to be considered valid.

Each sample train was carefully recovered. The H_2SO_4 solution in the first two impingers was quantitatively recovered in a glass sample container. The impingers and connecting glassware were then rinsed with water and added to the same sample jar. The contents of the third and fourth impingers were placed in a glass sample jar. The silica gel from the fifth impinger was weighed to determine the moisture gain.

Portions of the H_2SO_4 absorbing reagent was collected for a blank and diluted to the approximate volume of the corresponding sample jars with rinse water from the same wash bottle used. All liquid levels were marked. The H_2SO_4 sample jars and reagent blanks were sent to TestAmerica located in West Sacramento, California for HCl analysis by IC.

4.8 Metals Determination by Reference Method 29

USEPA RM 29, “Determination of Metals Emissions from Stationary Sources,” will be followed to determine the metals (Cd, Pb, Hg) emission rates exhausted by Unit 412. Included in the RM 29 sampling system will be a calibrated glass or Teflon coated stainless steel nozzle, stainless steel probe, glass or Teflon probe liner, insulated filter oven, glass filter holder and tared quartz-fiber filter, condenser assembly, and calibrated extraction system. The system vacuum will be used to extract the effluent gas through the interconnected, leak-free components. The entire system will be “leak checked” before and after each individual sample run to ensure sample integrity.

A “K-factor” (coefficient) will be determined prior to the initiation of each mercury sample run. This coefficient will be based upon preliminary measurements of gas temperature, flow rate, pressure, and moisture content. Multiplying the K-factor by the measured differential pressure will determine the isokinetic sample rate for each sample point. If a variable changes during a sample run, the coefficient will be adjusted to maintain isokinetic sampling rates. At isokinetic conditions, the velocity of the stack gas entering the nozzle of the extraction system will be equal to the effluent velocity at the sample point.

4.8.1 Sampling by Reference Method 29

By this method, cadmium, lead and mercury emissions were withdrawn isokinetically from the selected source, collected on a heated quartz fiber filter (maintained at a controlled temperature of 248 ± 25°F), and passed through a series of chilled impingers containing solutions of nitric acid/hydrogen peroxide (HNO_3/H_2O_2) and potassium permanganate ($KMnO_4$) as shown in **Figure 4-2**.

The sample components were recovered in separate front-half (probe wash and filter) and back-half (impinger solutions) fractions. The front-half and back-half components were rinsed with 0.1 normal (N) nitric acid (HNO_3) to capture all residue and collected in their respective containers. The probe wash, digested filter, and aliquots of impinger solutions were analyzed for the selected metals by inductively coupled plasma-mass spectroscopy (ICPMS) analysis or cold vapor atomic absorption (CVAA) analysis.

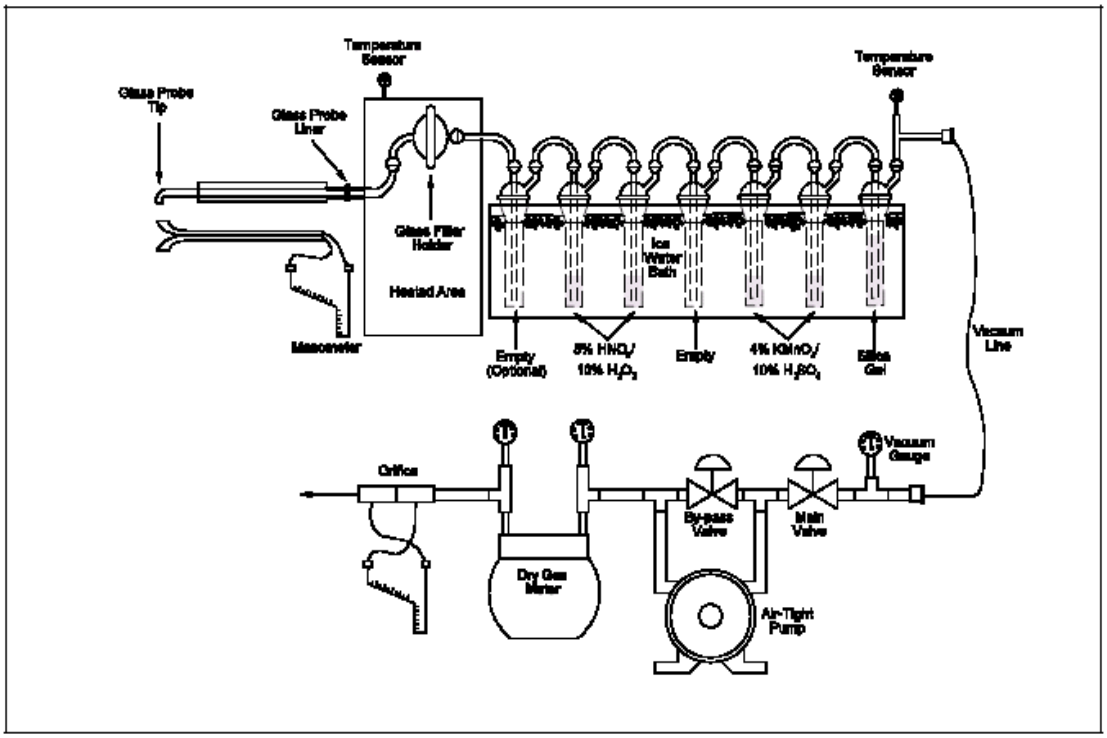


Figure 4-2 Reference Method 29 Sampling Train

The condenser assembly consisted of a series of six glass impingers with glass inserts interconnected to each other by glass U tubes, providing a “leak tight” seal with 28/15 ball and socket connections. The first and second impingers contained HNO_3/H_2O_2. The third impinger was left empty. The fourth and fifth impingers contained $KMnO_4$.The sixth impinger was filled with a pre weighed amount of silica gel to capture any residual moisture from the sample stream. The impinger train was set in an ice bath to maintain the extracted gas outlet temperature at or below 70°F. By cooling the sample, all water vapor and gases were condensed and collected. **Table 4-1** describes the condensate (impinger) train configuration for RM 29 testing including the $KMnO_4$ impingers which are exclusive to mercury capture and analysis.

Table 4-1 Reference Method 29 Condensate (Impinger) Train

Impinger No.	Contents	Configuration
1	100 ml HNO_3/H_2O_2	Straight
2	100 ml HNO_3/H_2O_2	Greenburg-Smith
3	Empty	Straight
4	100 ml $KMnO_4$ (Optional)	Straight
5	100 ml $KMnO_4$ (Optional)	Straight
6	200 - 300 g Silica Gel	Straight

Prior to sampling, the impingers and their contents were weighed and the initial weights recorded. Upon completion of sampling, the impingers were removed from the ice bath and the moisture gain determined gravimetrically by subtracting the final weight from the initial weight for each impinger.

Three valid sample runs were performed for each of the processes being tested. Upon completion of each sample run, the probe was removed from the exhaust stack and allowed to cool. A leak check of the sampling system was then performed to verify the integrity of the system. The leak rate must not exceed 0.02 acfm, in order for the test to be considered valid.

Each sample train was carefully recovered. The filter was removed from its sample holder with Teflon-coated or non-metallic tweezers and placed in a labeled petri dish. The nozzle, probe, and front-half of the filter holder were first rinsed with 0.1N HNO_3 to collect any of the selected metals that adhered to the front-half components. The rinse was quantitatively recovered in a glass sample container. The contents of the first two impingers were placed in a glass sample jar and the contents of the third impinge were placed in a separate sample jar. The impingers and filter back-half were then rinsed with 100 ml of 0.1N HNO_3 and added to the respective same sample jar. The contents of the fourth and fifth impingers were placed in a glass sample jar; these impingers were then rinsed with 100 ml of $KMnO_4$ and added to the same sample jar. The silica gel from the sixth impinger was weighed to determine moisture gain.

4.8.2 Analyses by Reference Method 29

Each recovered sample was composed of five fractions: a filter, HNO_3 front-half wash, HNO_3/H_2O_2 impinger contents with rinse, empty impinge with rinse and $KMnO_4$ impinger contents and rinse. The filter were digested and added to the probe wash for mercury analysis. Proportional aliquots of the probe rinse (front-half of the sample train) and samples recovered from impingers 1 and 2 and rinses, empty impinge and rinse (back-half of the sample train) were combined and analyzed for selected metals by ICPMS and mercury by CVAA.

4.9 Calculations and Nomenclature

The following section presents the calculations for determining flow rate, molecular weight, and moisture content. In addition, calculations for the determination of particulate concentration and pollutant emission rate are provided below. The nomenclature for each calculation also is defined.

Calculations

Stack Pressure (in Hg):

$$P_s = P_b + \frac{P_g}{13.6}$$

Volume of Water Collected (scf):

$$V_{wc(std)} = 0.04707 \times MG$$

Gas Meter Volume at Standard Conditions (dscf):

$$V_{m(std)} = V_m \times Y_d \times \left(\frac{T_{std}}{P_{std}} \right) \times \left(\frac{P_b + \frac{\Delta H_{avg}}{13.6}}{T_{m(avg)}} \right)$$

Fractional Moisture Content (dimensionless):

$$B_{ws} = \frac{V_{wc(std)}}{V_{wc(std)} + V_{m(std)}}$$

Moisture Content (%):

$$H_2O\% = B_{ws} \times 100$$

Molecular Weight (dry, lb/lb-mole):

$$M_d = (0.44 \times \%CO_2 + (0.32 \times \%O_2) + (0.28 \times (100 - \%CO_2 - \%O_2))$$

Molecular Weight (wet, lb/lb-mole):

$$M_s = M_d \times (1 - B_{ws}) + (18 \times B_{ws})$$

Velocity (feet per second):

$$v_s = 85.49 \; x \; C_p \; x \; \sqrt{\Delta p} \;\; x \; \sqrt{\frac{T_s}{P_s \; x \; M_w}}$$

Flow Rate (actual cubic feet per minute):

$$Q_a = V_s \times A_s \times 60$$

Flow Rate (dry standard cubic feet per minute):

$$Q_s = Q_a \times (1 - B_{ws}) \times 17.64 \times \left(\frac{P_s}{T_s} \right)$$

Percent Isokinetic (%):

$$\% \; I = \frac{0.09450 \; x \; T_s \; x \; V_{m(std)}}{P_s \; x \; v_s \; x \; A_n \; x \; \Theta \; x \; (\; 1 - B_{ws} \;)}$$

Particulate Concentration (lb/dscf):

$$C_{particulate} = \frac{MG_{particulate}}{453.5924 \; x \; V_{m(std)}}$$

Particulate Emission Rate (lb/hr):

$$E_p = C_{particulate} \; x \; dscfm \; x \; 60$$

Gaseous Pollutant Concentration (dry, ppm):

$$C_{gas} = (C^{/} - C_o) \times \left(\frac{C_{ma}}{C_m - C_o} \right)$$

Gaseous Pollutant Emission Rate (lb/hr):

$$E_{gas} = \frac{C_{gas}\ x\ MW\ x\ Q_s\ x\ 60}{385\ x\ 1{,}000{,}000}$$

Emissions of D/F (ng TEQ/dscm):

$$C_{(D/F)T} = \frac{\sum_{i=1}^{n} C_{(D/F)_i} TEF_i}{V_{m(std)}} \quad \frac{ng}{1{,}000\,pg} \quad \frac{(20.9 - 7)}{(20.9 - \%O_2)}$$

Nomenclature

A_n	Cross-Sectional Area of the Nozzle (square feet)
A_s	Cross-Sectional Area of the Stack (square feet)
B_{ws}	Water Vapor in Gas Stream (proportional by volume)
C’	Average Gas Concentration Indicated by Analyzer, dry basis (ppm)
CC	Confidence Coefficient (one tailed, 2.5% error)
C_{gas}	Corrected Effluent Gas Concentration, dry basis (ppm)
C_m	Average of Initial and Final System Calibration Bias Check Responses for the Upscale Calibration Gas (ppm)
C_{ma}	Actual Concentration of Upscale Calibration Gas (ppm)
C_o	Average of Initial and Final System Calibration Bias Check Responses for the Zero Gas (ppm)
C_p	Pitot Tube Coefficient, Dimensionless (0.84 for Type-S)
$C_{particulate}$	Particulate Concentration (lb//dscf)
$C_{(D/F)I}$	Concentration of D/F congener i in sample (pg/liter)
$C_{(D/F)T}$	Total concentration of D/F congeners in sample (ng/liter)
D/F	Stack concentration of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (ng TEQ/dscm)
ΔP	Average Velocity Head of Gas (in WC)
E_p	Particulate Emission Rate (lb/hr)
$H_2O\%$	Moisture Content of Gas Stream (%)
M_d	Molecular Weight of Stack Gas, dry basis (lb/lb-mole)
M_s	Molecular Weight of Stack Gas, wet basis (lb/lb-mole)

$MG_{particulate}$	Particulate mass gain (mg)
MW	Molecular Weight of Pollutant (SO_2 = 64, NO_X = 46, CO = 28)
ng	nanograms (10^{-9} grams)
pg	picograms (10^{-12} grams)
P_b	Uncorrected Barometric Pressure (in Hg)
P_g	Static Pressure of Stack Gas (in WC)
P_s	Absolute Pressure of Stack Gas (in Hg)
P_{std}	Standard Absolute Pressure (29.92 in. Hg)
$\%CO_2$	Percent Carbon Dioxide, Dry Basis
$\%O_2$	Percent Oxygen, Dry Basis
%I	Isokinetic sample rate (%)
Q_a	Actual Flow Rate (acfm)
Q_s	Dry Standard Flow Rate (dscfm)
RM	Reference Method (RM 6C, RM 7E or RM 10) Data Average (Arithmetic Mean)
$T_{m(avg)}$	Average DGM Absolute Temperature (°R)
T_s	Average Stack Gas Temperature (°R)
V_s	Average Gas Velocity (feet per minute)
T_{std}	Standard Absolute Temperature (528 °R)
V_m	Dry Gas Volume as Measured by the DGM (dcf)
$V_{m(std)}$	Dry Gas Volume Corrected to Standard Conditions (dscf)
$V_{wc(std)}$	Volume of H_2O Collected in Impingers and Silica Gel Corrected to Standard Conditions (ml)
Y_d	DGM Calibration Factor
Θ	Sample Time (minutes)

5.0 Quality Assurance/Quality Control

5.1 Objectives

The objectives of AECOM's QA/QC program are as follows:

- To continually monitor the precision and accuracy of the data being generated for all source emission measurements.
- To implement measures designed to control the precision and accuracy of all data generated for individual sources.
- To maintain permanent records of analytical QC data and equipment calibrations that include traceability and certification.
- To identify, document, and maintain a COC log, which accounts for each method sample collected during each measurement program.

5.2 Field Program

All primary, USEPA-approved testing procedures selected for this test program are referenced in the 40 CFR 60, Appendix A. No deviations from these procedures were expected or necessary. All field personnel responsible for this emission test program strictly followed the procedures dictated by the applicable test methods.

All field test personnel involved with this test program are experienced and trained in field sampling methods and procedures. Each field personnel was assigned key responsibilities in phases of sample collection, sample recovery, COC, and transportation of samples. Basic responsibilities for field personnel include, but are not limited to:

Record keeping. Field Personnel recorded all pertinent test parameters and relevant observations on the appropriate field data forms.

Safety requirements. Field personnel are familiar with all company safety regulations and are provided with all the necessary safety equipment.

Sample handling. Field personnel are trained in the proper procedures for handling samples including: use of sample containers, sample preservation, identification, storage of collected samples, and COC.

Instrumentation. Specific field personnel are trained in the proper operation, calibration, trouble shooting, and maintenance of the instrumentation intended for this program. This includes the use of pumps, control console(s), samplers, and instrumentation.

Quality control (QC). Field personnel are trained in all aspects of QC that relate directly to the specific reference method test procedures, sample handling, analyses, and reporting.

Mr. John Rosburg, of AECOM, is the designated field manager and was responsible for coordinating testing activities with Pogo and ADEC. He provided answers to questions concerning test methodology, QC, and all other project aspects. The field manager was also responsible for delegating work assignments to the members of the test crew, making sure all QA/QC procedures are carried out, and documenting all field activities in a bound log book.

All field instrumentation was maintained and calibrated according to all applicable USEPA guidelines. Records of instrument maintenance and calibration are kept in historical files and continually updated. Calibrations of all field instrumentation, at a minimum, meet or exceed the mandated procedures stipulated in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III. All documentation of calibrations are maintained on file at all times. Calibration documentation for the equipment used in this test program is provided in the Appendices of this test report.

5.3 Sample Documentation

All field data collected for each selected reference method test procedure was documented on field data forms. Each form, specific to each particular sample run, included information as to the source tested, date and time of sample collection, analyst(s) performing the test, and all data necessary for test validation. Each field data sheet was completed by the responsible technician at the time of the test and checked by the Field Manager for accuracy and completeness after each test series. Copies of all raw field data sheets are included in the appendices of this test report, with the originals maintained in project files at AECOM's Fort Collins office.

Sample containers utilized for the collection and storage of samples are specific to each test procedure. Filter substrates were maintained in individually labeled polyethylene Petri dishes sufficient in size to receive the samples unaltered and with the exposed surface protected from sample loss.

Collection of all blanks was specific to each test performed. The field blanks were collected at the test location and subjected to the same ambient conditions as the samples. This type of blank was collected for each reagent used in each test series and analyzed in the same manner as the sample itself.

Each recovered sample was labeled with standard sample tags and uniquely identified. The tags provided information regarding the unit tested, sample location, date and time of collection, reagent(s) used, and the test number. The sample containers were sealed, liquid level marked (if applicable), and properly stored until they were transported to the laboratory.

Standard COC forms were completed before any samples were transported to the laboratory. This procedure is dictated by the USEPA and strictly adhered to by AECOM. Each sample was tagged with a COC tag, which requires the same information as the field sample label.

5.4 Analytical Quality Control

All analytical procedures used for this program are approved by the USEPA and referenced in 40 CFR 60 (where applicable). AECOM's QA/QC program meets or exceeds USEPA standards. All particulate gravimetric analysis was performed by TestAmerica in West Sacramento, California. The D/F XAD-2 resin traps and filters were prepared by Analytical Perspectives of Wilmington, North Carolina who also performed the sample RM 23 analyses. The metals (Cd, Pb, Hg) and HCl analyses were performed by TestAmerica.

5.5 Data Reduction, Validation, and Reporting

AECOM has implemented specific measures to ensure that reliable data is generated as a result of the sampling and analytical activities of every field program. The objective of this phase of AECOM's QA/QC program is to follow the proper collection of representative and QA field and analytical data with approved data reduction methods and equations.

All calculations are performed using QA spreadsheets incorporating standard accepted equations, as required by the applicable pollutant specific sampling methodology. Data reduction was performed by qualified engineers or data analysts familiar with standard engineering practices and approved methods. Calculation methods and equations, including conversion factors and units, are defined in this test report

to allow the reviewer to easily reproduce the final results from the raw field data and process information provided in the appendices of the report. This final report includes all raw data, QA/QC documentation, and process data collected during the test program. The initial draft of this test report, including both narrative and calculations, was subjected to review by the project manager and/or Principal-in-Charge, prior to final publication.